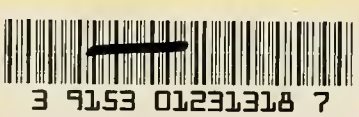

The Connecticut Agricultural Experiment Station, New Haven

New Tobacco Cyst Nematode Resistant Shade Tobacco Varieties

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Two varieties of Connecticut shade tobacco (*Nicotiana tabacum* L.) resistant to the tobacco cyst nematode, *Globodera tabacum tabacum* (Lownsbery & Lownsbery) Stone, have been developed at The Connecticut Agricultural Experiment Station's Valley Laboratory. These varieties, 'Poquonock' and 'Metacomet', allow shade tobacco production in cyst nematode-infested soils without the annual use of fumigant nematicides. Yields and sorting qualities are equal to or better than the nematode-susceptible shade variety 'O-40'. Limited quantities of seed are available to growers and scientists.

The tobacco cyst nematode was first discovered in Hazardville, CT in the early 1950's (Lownsbery and Lownsbery, 1954). It is now widely distributed in shade production areas in the Connecticut River Valley of Connecticut and Massachusetts. A related nematode, *Globodera tabacum solanacearum* (Miller and Gray, 1972) Stone, suppresses the growth and yield of tobacco in Virginia and North Carolina (Komm et al., 1983; Melton et al., 1991). Nematode infection of roots can cause dramatic stunting, yield loss, and reduce leaf quality. A nonlinear damage function was developed to predict shade tobacco yield losses based on preplant nematode densities in soil (LaMondia, 1995). Losses can exceed 40 percent in Connecticut at high nematode densities. Nematode losses have been prevented by the use of preplant fumigation of soils. However, fumigant nematicide use is expensive and the number of fumigants available for use has been reduced due to environmental considerations.

BREEDING AND SELECTION

All Connecticut shade and broadleaf varieties tested were susceptible to *G. t. tabacum* (LaMondia, 1991). Flue-cured tobacco lines with resistance to *G. t. solanacearum* were found resistant to *G. t. tabacum* (LaMondia, 1988), and crosses to Connecticut shade tobacco were begun in 1987. Resistance to *G. t. tabacum* was later determined to be conferred by a single dominant gene (LaMondia, 1991).

Both Poquonock and Metacomet are inbreds derived from a cross between the nematode-susceptible Connecticut shade tobacco line 'O-30' and the nematode-resistant flue-cured line VA-81. Resistance to *G. t. tabacum* and *G. t. solanacearum* may be linked to wildfire (*Pseudomonas tabaci* Wolf & Foster, Stevens) resistance (Spasoff, 1971). Wildfire resistance was transferred from *Nicotiana longiflora* to the breeding line TL 106, which had a pair of chromosomes from the wild species (Clayton, 1947). *Nicotiana longiflora* was resistant to *G. t. solanacearum* in pot experiments (Baalawy and Fox, 1971). Metacomet was selected and inbred over 12 selfed generations of field evaluation for horticultural characteristics and greenhouse evaluation for *G. t. tabacum* resistance. Poquonock was selected after backcrossing to Connecticut types to incorporate the resistance gene into a predominantly Connecticut shade background. The original O-30 and VA-81 cross was back-crossed to O-30 twice, back-crossed to the nematode-susceptible shade line O-40 twice, then crossed again to a selfed inbred (selfed for three generations) of O-30 and VA-81. The resulting line was selfed to homogeneity (stable inbred genetics) over six generations. For both varieties, individual plants in the F2 and F4 generations were selected for cyst nematode resistance using a greenhouse seedling assay (LaMondia, 1991). Progeny testing was performed in 1993 to select plants homozygous for *G. t. tabacum* resistance.

Poquonock and Metacomet both contain the dominant hypersensitive gene for resistance to tobacco mosaic virus derived from *Nicotiana glutinosa* L. Both lines have also been selected for reduced sensitivity to weather fleck caused by ozone. Flue-cured tobacco varieties with resistance to *G. t. solanacearum* were intolerant of infection, and required nematicide use to maintain yields of resistant plants (Komm et al, 1983). We selected Poquonock and Metacomet under field conditions for growth and yield in the presence of damaging population levels of *G. t. tabacum* to avoid severe problems with intolerance to nematode infection.

EVALUATION AND PERFORMANCE

The effects of nematode resistance on *G. t. tabacum* populations were determined in field plots in a cloth-covered shade tent at the Experiment Station's Valley Laboratory in Windsor in 1993, 1994, and in 1997. Plants were grown in four rows in replicate 25m^2 plots. Nematode densities were determined from 25 composite core samples to 15 cm deep taken prior to planting and again after harvest. Cysts were recovered from soil by flotation in a modified Fenwick can, crushed, and the number of juveniles in eggs counted. Changes in density were expressed as the ratio of final to initial counts (Pf/Pi). Nematode resistant varieties reduced population densities in soil by approximately 70% (Table 1).

Table 1. The effects of nematode resistant or susceptible shade tobacco varieties on *G. t. tabacum* populations in naturally infested soils.

		Pf/Pi ratio*		
Variety	Reaction	1993	1994	1997
O-40	Susceptible	2.91	2.97	3.01
Metacomet	Resistant	0.17	0.26	0.28
Poquonock	Resistant	ND	0.33	0.37
P=		0.001	0.001	0.001

* Nematode population change expressed as the ratio of final to initial densities.

Table 2. Yield and quality characteristics of *G. t. tabacum* resistant or susceptible tobacco varieties.

		Yield/plant (g)		Quality Grade (%)1996*			$ Value per+
Variety	Reaction	1993	1996	1	2	3	45 kg 1993
O-40	Susceptible	466.1	614.7	46	20	33	1,088
Metacomet	Resistant	746.3	759.6	26	36	38	1,902
Poquonock	Resistant		731.9	44	43	13	1,980
P=		0.09	0.001				

* Grade 1 = excellent wrapper quality, grade 3 = poor.

+ Economic value determined by price per grade and cured leaf weight, 1993.

Over the same time period, nematode populations increased by about 200% in soil where a susceptible variety grew. The population reduction resulting from the season-long production of a resistant variety is comparable to growing a nematode-susceptible variety with soil fumigation (LaMondia, 1993).

Leaf yield and quality of Metacomet, Poquonock and the nematode-susceptible O-40 were compared in field plots infested with 120 to 250 infective *G. t. tabacum* juveniles per cm^3 soil (Table 2). Fresh weight yields were similar or greater for nematode-resistant varieties compared to the O-40 standard. Cured leaf quality was determined from samples submitted to commercial shade tobacco producers for curing and evaluation. Quality of Metacomet and Poquonock, as determined by percent weight in each grade in 1996, and by economic value of yields in 1993, was comparable to or better than O-40.

Metacomet and Poquonock shade varieties will allow the production of high quality shade tobacco in fields infested with damaging populations of *G. t. tabacum*. These varieties give growers a non-chemical control which will reduce nematode populations as well as a fumigant nematicide.

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